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Site Evaluation for Application of Fuel Cell Technology

Little Rock Air Force Base, AR

Michael J. Binder, Franklin H. Holcomb, and William R. Taylor

May 2001

Construction Engineering Research Laboratory

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Foreword

In fiscal years 93 and 94, Congress provided funds for natural gas utilization equipment, part of which was specifically designated for procurement of natural gas fuel cells for power generation at military installations. The purchase, installation, and ongoing monitoring of 30 fuel cells provided by these appropriations has come to be known as the "DoD Fuel Cell Demonstration Program." Additional funding was provided by: the Office of the Deputy Under Secretary of Defense for Industrial Affairs & Installations, ODUSD (IA&I)/HE&E; the Strategic Environmental Research & Development Program (SERDP); the Assistant Chief of Staff for Installation Management (ACSIM); the U.S. Army Center for Public Works (CPW); the Naval Facilities Engineering Service Center (NFESC); and Headquarters (HQ), Air Force Civil Engineer Support Agency (AFCESA).

The work was performed by the Energy Branch (CF-E), of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Michael J. Binder. This report documents work done at Little Rock Air Force Base (AFB), Jacksonville, AR. Special thanks is owed to the Little Rock AFB points of contact (POCs) Joe Johnston and Michael McClendon for providing investigators with access to needed information for this work. Part of this work was performed by Science Applications International Corp. (SAIC), under Contract DACA88-94-D-0020, task orders 0002, 0006, 0007, 0010, and 0012. The technical editor was William J. Wolfe, Information Technology Laboratory. Larry M. Windingland is Chief, CEERD-CF-E, and L. Michael Golish is Chief, CEERD-CF. The associated Technical Director was Gary W. Schanche, CEERD-CV-T. The Acting Director of CERL is William D. Goran.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Director of ERDC is Dr. James R. Houston and the Commander is COL James S. Weller.

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1 Introduction

Background

Fuel cells generate electricity through an electrochemical process that combines hydrogen and oxygen to generate direct current (DC) electricity. Fuel cells are an environmentally clean, quiet, and a highly efficient method for generating electricity and heat from natural gas and other fuels. Air emissions from fuel cells are so low that several Air Quality Management Districts in the United States have exempted fuel cells from requiring operating permits. Today's natural gas-fueled fuel cell power plants operate at electrical conversion efficiencies of 40 to 50 percent; these efficiencies are predicted to climb to 50 to 60 percent in the near future. In fact, if the heat from the fuel cell process is used in a cogeneration system, efficiencies can exceed 85 percent. By comparison, current conventional coal-based technologies operate at efficiencies of 33 to 35 percent.

Phosphoric Acid Fuel Cells (PAFCs) are in the initial stages of commercialization. While PAFCs are not now economically competitive with other more conventional energy production technologies, current cost projections predict that PAFC systems will become economically competitive within the next few years as market demand increases.

Fuel cell technology has been found suitable for a growing number of applications. The National Aeronautics and Space Administration (NASA) has used fuel cells for many years as the primary power source for space missions and currently uses fuel cells in the Space Shuttle program. Private corporations have recently been working on various approaches for developing fuel cells for stationary applications in the utility, industrial, and commercial markets. Researchers at the U.S. Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL) have actively participated in the development and application of advanced fuel cell technology since fiscal year 1993 (FY93), and have successfully executed several research and demonstration work units with a total funding of approximately $55M.

As of November 1997, 30 commercially available fuel cell power plants and their thermal interfaces have been installed at DoD locations, CERL managed 29 of these installations. As a consequence, the Department of Defense (DoD) is the

owner of the largest fleet of fuel cells worldwide. CERL researchers have developed a methodology for selecting and evaluating application sites, have supervised the design and installation of fuel cells, and have actively monitored the operation and maintenance of fuel cells, and compiled "lessons learned" for feedback to manufacturers. This accumulated expertise and experience has enabled CERL to lead in the advancement of fuel cell technology through major efforts such as the DoD Fuel Cell Demonstration, the Climate Change Fuel Cell Program, research and development efforts aimed at fuel cell product improvement and cost reduction, and conferences and symposiums dedicated to the advancement of fuel cell technology and commercialization.

This report presents an overview of the information collected at Little Rock Air Force Base (AFB), AR along with a conceptual fuel cell installation layout and description of potential benefits the technology can provide at that location. Similar summaries of the site evaluation surveys for the remaining 28 sites where CERL has managed and continues to monitor fuel cell installation and operation are available in the companion volumes to this report (Table 1).

Objective

The objective of this work was to evaluate Little Rock AFB as a potential location for a fuel cell application.

Approach

On 29 and 30 May 1996, CERL and SAIC representatives visited Little Rock Air Force Base (the Site) to investigate it as a potential location for a 200 kW fuel cell. This report presents an overview of information collected at the site along with a conceptual fuel cell installation layout and description of potential benefits. The Appendix to this report contains a copy of the site evaluation form filled out at the site.

Table 1. Companion ERDC/CERL site evaluation reports.

Location	Report No.
Pine Bluff Arsenal, AR	TR 00-15
Naval Oceanographic Office, John C. Stennis Space Center, MS	TR 01-3
Fort Bliss, TX	TR 01-13
Fort Huachuca, AZ	TR 01-14
Naval Air Station Fallon, NV	TR 01-15
Construction Battalion Center (CBC), Port Hueneme, CA	TR 01-16
Fort Eustis, VA	TR 01-17
Watervliet Arsenal, Albany, NY	TR 01-18
911th Airlift Wing, Pittsburgh, PA	TR 01-19
Westover Air Reserve Base (ARB), MA	TR 01-20
Naval Education Training Center, Newport, RI	TR 01-21
U.S. Naval Academy, Annapolis, MD	TR 01-22
Davis-Monthan Air Force Base (AFB), AZ	TR 01-23
Picatinny Arsenal, NJ	TR 01-24
U.S. Military Academy, West Point, NY	TR 01-28
Barksdale AFB, LA	TR 01-29
Naval Hospital, Naval Air Station Jacksonville, FL	TR 01-30
Nellis AFB, NV	TR 01-31
Naval Hospital, Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms, CA	TR 01-32
National Defense Center for Environmental Excellence (NDCEE), Johnstown, PA	TR 01-33
934th Airlift Wing, Minneapolis, MN	TR 01-38
Laughlin AFB, TX	TR 01-41
Fort Richardson, AK	TR 01-42
Kirtland AFB, NM	TR 01-43
Subase New London, Groton, CT	TR 01-44
Little Rock AFB, AR	TR 01-47
Edwards AFB, CA	TR 01-Draft
Naval Hospital, Marine Corps Base Camp Pendleton, CA	TR 01-Draft
U.S. Army Soldier Systems Center, Natick, MA	TR 01-Draft

Units of Weight and Measure

U.S. standard units of measure are used throughout this report. A table of conversion factors for Standard International (SI) units is provided below.

1 ft	=	0.305 m
1 mile	=	1.61 km
1 acre	=	0.405 ha
1 gal	=	3.78 L
°F	=	°C (X 1.8) + 32

2 Site Description

Little Rock AFB is located adjacent to Jacksonville, AR, approximately 17 mi north of Little Rock. It is home to the 314th Airlift Wing, which has the dual mission of worldwide airlift and airlift crew training. As such, the Wing organizes, equips, and trains combat-ready airlift units to operate anywhere in the world. It is responsible for all C-130 training for the Department of Defense, the Coast Guard, and many allied nations.

ASHRAE design temperatures for this site are 20 °F for the winter and 96 °F for the summer.

The primary focus for the fuel cell site evaluation was the base hospital. The hospital is currently a 12-bed facility, but is downsizing to a same-day surgery and outpatient clinic. The 52,403 sq ft facility is constructed of brick and concrete walls and has a built-up roof. The facility is open around the clock, but is primarily occupied between 7:30 a.m. and 4:30 p.m.

The mechanical room at the hospital houses three steam boilers that are used for space heating and reheating, sterilization, and domestic hot water (DHW). Steam and hot water are used for space heating and reheat systems in 10 air handling units. In the summer (May–October), extensive use of reheating is used to control humidity. The average hot water temperature supplied to the air handlers during reheat is about 110 °F. The heating season is typically November through April. During the coldest months (January and February), about 160 °F hot water is supplied to the air handlers. During the balance of the heating season, about 140 °F hot water is supplied to the air handlers.

The mechanical room also houses three centrifugal chillers, a condensate tank, three 370-gal hot water storage tanks, two back-up generators, electrical switchgear panels, and various pumps. The two back-up generators have capacities of 750 kW and 200 kW. The operation and reliability of the back-up system is not optimal and will require modifications in the near future. Power quality is an issue since the hospital contains computers and other specialized equipment that are effected by power outages, spikes, and harmonic distortion.

Site Layout

Figure 1 presents the site layout for Little Rock AFB. The hospital is identified as Building 1090, Medical Facilities, near the intersection of Arnold Drive and Texas Boulevard.

Figure 2 presents a more detailed layout of the hospital facility around the mechanical room, located at the southeast corner of the building. Just outside the mechanical room is a walled-in area that contains two cooling towers. The mechanical room houses three steam boilers, three 370-gal steam-heated hot water tanks, pumps, a condensate tank, three centrifugal chillers, two back-up generators, and electrical panels. Adjacent to the mechanical room is a grassy courtyard that is fairly level. The building gas meter is located near the entrance to the mechanical room.

Electrical System

The base grid is at 13,800 volts and the Hospital is fed through a 480/13,800 V, 1,300 kVA transformer.

Steam/Hot Water System

The hospital has three boilers, which are rated at 150 horsepower each. The boilers nominally produce about 60 psi steam. The steam is used to heat three storage tanks that provide domestic hot water and space heating. The cooling systems also use hot water and steam for reheat to control humidity levels. Typically, two of the three boilers will operate at the same time.

Space Heating System

Space heating is provided through a steam/hot water heat exchanger located in the mechanical room. The water is supplied at temperatures between 140 and 160 °F, depending on outside air temperature.

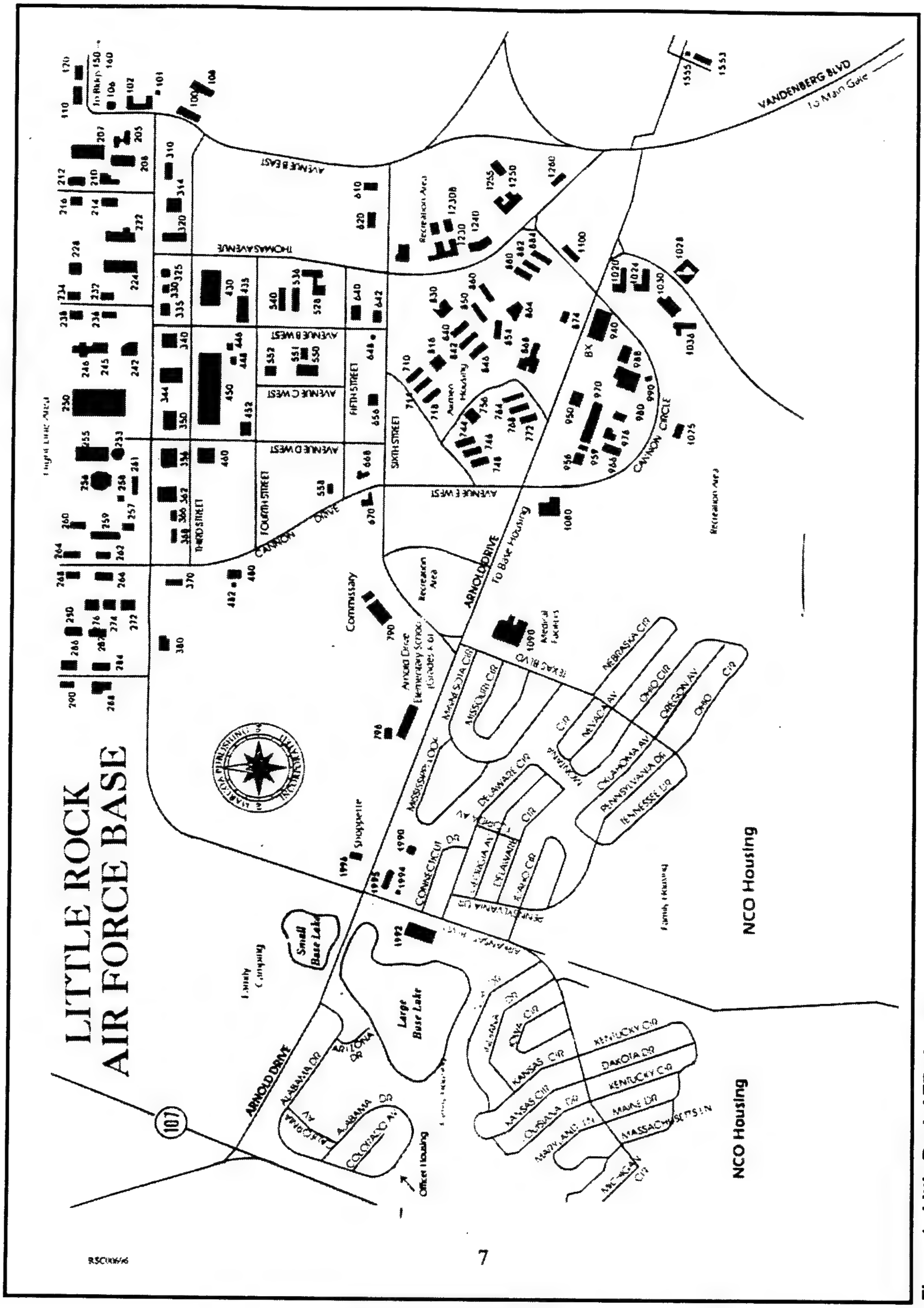

Figure 1. Little Rock AFB site map.

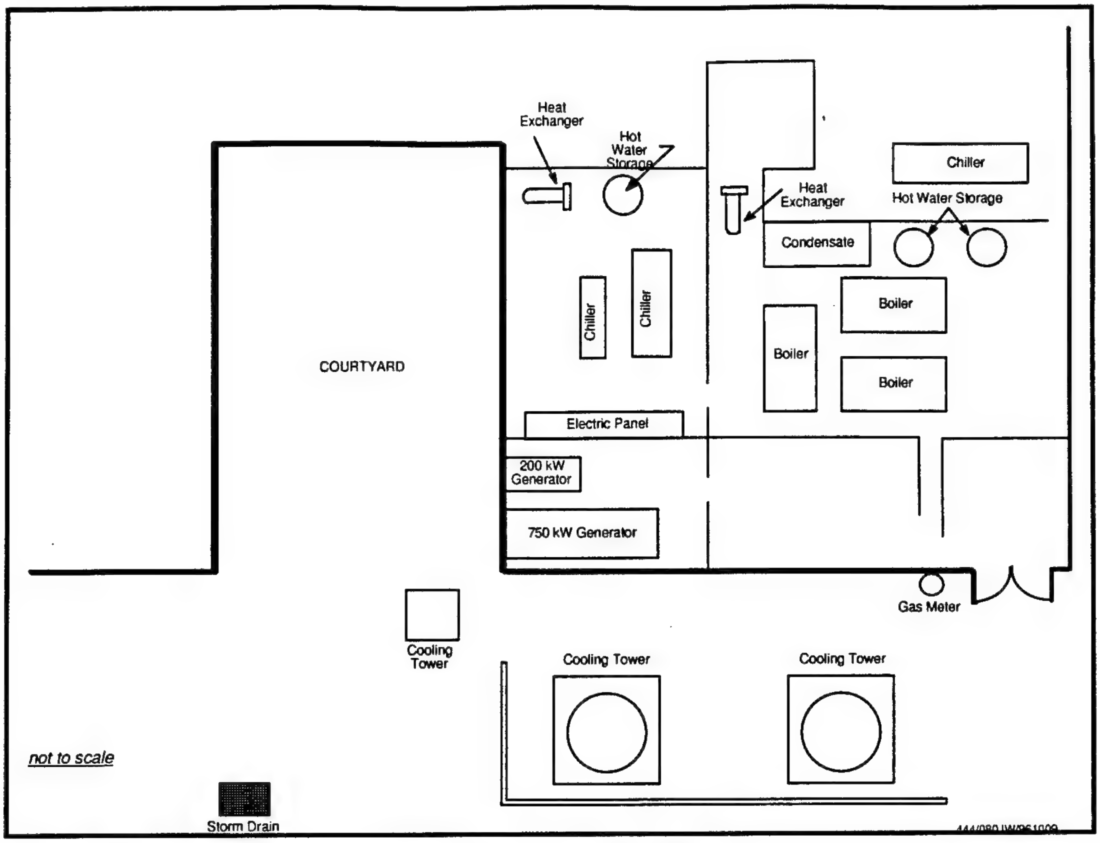

Figure 2. Hospital site layout—mechanical room and courtyard.

Space Cooling System

The hospital has three centrifugal chillers. Two of the chillers are rated at 300 tons and are manufactured by Trane (Model #: CVHE320). The other chiller is rated at 150 tons and is manufactured by McQuay (Model #: EO48AGO8ROX). The chilled water is distributed throughout the hospital to the fan coils. The systems are configured for cool/reheat to control humidity levels in the hospital. Water at 110 °F is supplied by the steam/hot water heat exchanger for reheat. The operating room spacing conditioning must be kept within strict tolerances at all times. The chillers typically operate from May through October.

Fuel Cell Location

The fuel cell should be located in the grassy courtyard adjacent to the mechanical room (Figure 3). The fuel cell should run in the east-west direction with the thermal outlet side facing the mechanical room to minimize the thermal piping run. The cooling module should be positioned behind the fuel cell and the N_2 bottles up against the mechanical room wall.

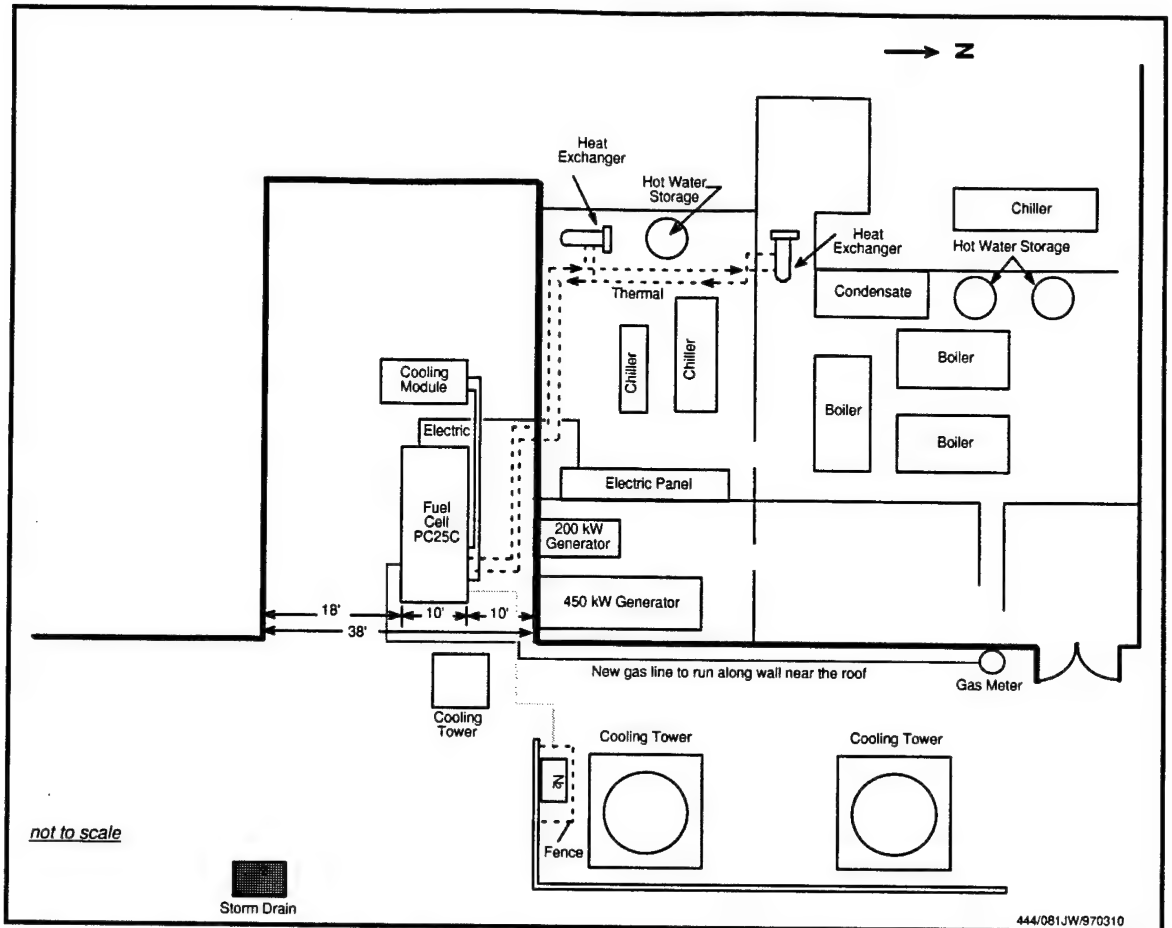

Figure 3. Fuel cell location and site interfaces.

Fuel Cell Interfaces

The longest thermal run will be about 100 ft to the heat exchanger in the old mechanical room. The natural gas line should run up the wall and along the roof. This run would be about 140 ft. The electric run would be around the power plant and straight through the wall, about 40 ft. The cooling module piping would be about 25 ft.

The hospital uses 480V electricity fed through a 480/13,800 V, 1,300 kVA transformer. The fuel cell electrical output should be connected at the spare slot in the electric panel in the mechanical room. The lowest monthly peak electric demand in FY 95 was 672 kW. At this peak demand it is likely that all (or nearly all) of the fuel cell output will be used within the hospital. Any output above the hospital demand would be fed through the 1,300 kVA transformer into the grid. Base personnel stated that there are currently plans for the installation of two new 1,000 kW backup generators at the hospital. Because of this, there is no need to provide fuel cell grid independent capability.

It is recommended that the fuel cell thermal output be used to heat the hot water supplied to the air handlers for space heating and reheating the cooled air for humidity control. For 6 months of the year (May–October), the hospital is cooled and reheat is used. In the reheat mode, the two steam heat exchangers heat water to about 110 °F, which is fed to the air handlers and returns at between 90 and 100 °F. The design flow rate was determined to be 66 gpm for one of the two hot water loops. It was assumed that both loops operate at the same flow rate. The fuel cell should be interfaced with both heating loops. Assuming a return temperature of 95 °F, the reheat hot water load is estimated as follows:

$$992 \text{ kBtu/hr} = (66 \text{ gpm})(2)(8.35 \text{ lb/gal})(60 \text{ min/hr})(110\ °\text{F} - 95\ °\text{F})(0.001 \text{ kBtu/lb °F})$$

The fuel cell would heat 25 gpm of the about 95 °F return water. Under these conditions, the entire 700 kBtu/hr available from the fuel cell would be recovered. The fuel cell stream would heat the total return stream to 106 °F:

$$106\ °\text{F} = (700\text{kBtu/hr}) / ((132\text{gpm})(8.35 \text{ lb/gal})(0.001 \text{ kBtu/lb °F})(60 \text{ min/hr})) + 95\ °\text{F}$$

The heating season typically runs from November through April. Hot water is supplied to the coils at approximately 160 °F during January and February and at approximately 140 °F during November, December, March, and April. There is a 20 °F temperature drop across the fan coils in the air handler. Therefore, the return temperature is about 140 °F during January and February, and about 120 °F during the balance of the heating season.

During January and February, the fuel cell would heat 25 gpm of 140 °F return water. Under these conditions, 400 kBtu/hr of fuel cell heat would be recovered based on the heat exchanger map provided in the PC25C Installation Manual. The fuel cell would heat the total return stream to about 146 °F:

$$146\ °\text{F} = (400 \text{ kBtu/hr}) / ((132 \text{ gpm})(8.35 \text{ lb/gal})(0.001 \text{ kBtu/lb °F})(60 \text{ min/hr})) + 140\ °\text{F}$$

During November, December, March and April, the fuel cell would heat 25 gpm of 120 °F return water. Under these conditions, 560 kBtu/hr of fuel cell heat would be recovered based on the heat exchanger map provided in the PC25C Installation Manual. The fuel cell would heat the return stream to about 128 °F:

$$128\ °\text{F} = (560 \text{ kBtu/hr})/((132\text{gpm})(8.35 \text{ lb/gal})\ (0.001 \text{ kBtu/lb °F})(60 \text{ min/hr})) + 120\ °\text{F}$$

The total fuel cell thermal use for this application, including space heat and reheat, would be 5,297 MBtu/year:

$$5{,}297 \text{ MBtu} = ((700 \text{ kBtu/hr})(4{,}416 \text{ hr})+(560 \text{ kBtu/hr})(2{,}928 \text{ hr})+(400 \text{ kBtu/hr})(1{,}416 \text{ hr})) /1{,}000 \text{ kBtu/MBtu}.$$

This represents a fuel cell thermal utilization of 86 percent:

$$86\% = (5{,}297 \text{ MBtu/yr}) / ((0.700 \text{ MBtu/hr})(8{,}760 \text{ hr/yr}))$$

The fuel cell thermal interface is shown in Figure 4. The return water should be pulled from both return lines through the fuel cell and returned prior to the steam heat exchangers. A 25 gpm circulating pump should be used to control the flow. The pump should run whenever the fuel cell operates and when both of the supply temperatures are below the setpoints. Balancing valves should be used to provide the desired flow from the fuel cell to each heat exchanger.

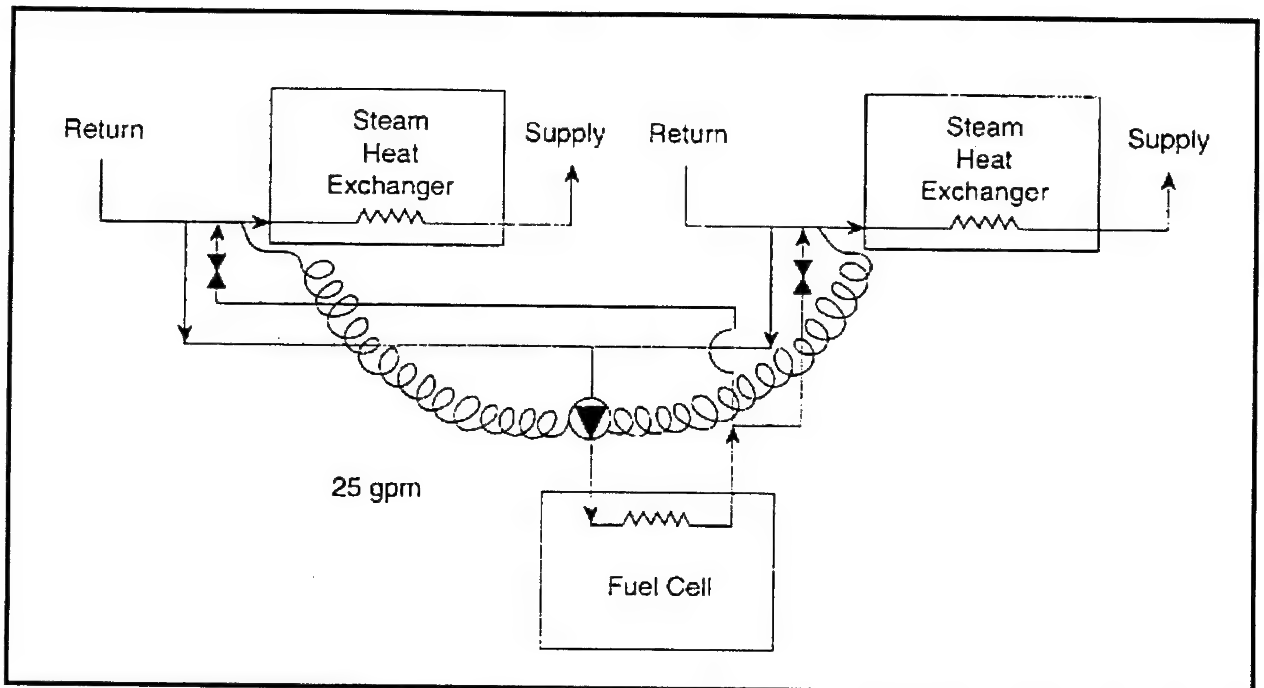

Figure 4. Fuel cell thermal interface—hospital.

3 Economic Analysis

The base purchases electricity from Arkansas Power & Light under rate schedule PT4. The base is billed on the basis of monthly demand and energy consumption. The demand charge is $11.06/kW from October through May and increases to $13.24/kW from June through September. The energy charge is $0.057/kWh for the entire year. Table 2 lists electrical bills for FY95. The base purchases natural gas from ARKLA Gas under the Commercial Gas Service Schedule. The rate schedule is a block schedule with declining rates as consumption increases. The hospital is billed at an average rate of $3.30/MCF. Table 3 lists the hospital gas use and cost for FY95.

Savings from the operation of the fuel cell is calculated based on a 90 percent fuel cell electric capacity factor. Demand savings is based on 12 months demand reduction at 200 kW.

Demand:

[(200 kW) (8 mo) ($11.06/kW)] + [(200 kW) (4 mo) ($13.24/kW)] = $28,288

Energy:

(200 kW) (0.9) (8,760 hr/yr) ($0.057/kWh) = $89,878

Total annual fuel cell electric savings is estimated to be $118,166.

Table 2. Little Rock AFB Hospital FY95 electricity consumption and costs.

Month	kW	$/kW	Demand Cost	kWh	$/kWh	Energy Charge	Total Cost
October	728	$11.06	$8,052	375,200	$0.057	$21,386	$29,438
November	700	$11.06	$7,742	364,000	$0.057	$20,748	$28,490
December	672	$11.06	$7,432	344,400	$0.057	$19,631	$27,063
January	700	$11.06	$7,742	386,400	$0.057	$22,025	$29,767
February	728	$11.06	$8,052	386,400	$0.057	$22,025	$30,076
March	700	$11.06	$7,742	344,400	$0.057	$19,631	$27,373
April	700	$11.06	$7,742	352,800	$0.057	$20,110	$27,852
May	798	$11.06	$8,826	386,400	$0.057	$22,025	$30,851
June	798	$13.24	$10,566	407,400	$0.057	$23,222	$33,787
July	1,148	$13.24	$15,200	455,000	$0.057	$25,935	$41,135
August	840	$13.24	$11,122	536,200	$0.057	$30,563	$41,685
September	854	$13.24	$11,307	439,600	$0.057	$25,057	$36,364
Total			**$111,523**	**4,778,200**		**$272,357**	**$383,881**

Table 3. Little Rock AFB Hospital FY95 natural gas consumption and costs.

Date	MCF	$/MCF	Cost
October	1,343	$3.30	$4,432
November	671	$3.30	$2,214
December	996	$3.30	$3,287
January	1,135	$3.30	$3,746
February	851	$3.30	$2,808
March	844	$3.30	$2,785
April	404	$3.30	$1,333
May	1,020	$3.30	$3,366
June	635	$3.30	$2,096
July	848	$3.30	$2,798
August	787	$3.30	$2,597
September	675	$3.30	$2,228
Total	**10,209**		**$33,690**

It was estimated that the fuel cell would displace 5,297 MBtu/yr (86 percent thermal utilization). Assuming a displaced boiler efficiency of 75 percent and a fuel cell capacity factor of 90 percent, the fuel cell would displace 6,356 MBtu/yr:

6,356 MBtu/yr = (5,297 MBtu/yr)(90% capacity factor) / (75% boiler eff.)

Using an average natural gas rate of $3.20/MBtu ($3.30/MCF/1.03 MBtu/MCF) a thermal cost savings of $20,339 was calculated for the fuel cell.

$20,339 = (6,356 MBtu/yr)($3.20/MBtu)

The natural gas cost for fuel cell input fuel is $3.20/MBtu. The fuel cell will consume 14,949 MBtu per year based on an electrical efficiency of 36 percent HHV (higher heating value). Input natural gas cost for the fuel cell would be $47,837.

The estimated annual net savings for a full 12 months of demand savings and a thermal utilization of 86 percent is $90,668 as shown in Table 4. Also shown in the table is the impact of achieving only 6 months of demand savings, zero months of demand savings and 100 percent thermal utilization.

This analysis is a general overview of the potential savings from the fuel cell. For the first 56 months, ONSI will be responsible for the fuel cell maintenance. Maintenance costs are not reflected in this analysis, but could represent a significant impact on net energy savings. Since detailed load energy profiles were not available, net energy savings could vary depending on actual thermal and electrical utilization.

Table 4. Economic savings of fuel cell installation.

Case	ECF	TU	Displaced kWh	Displaced Gas (MBtu)	Electrical Savings	Thermal Savings	Nat. Gas Cost	Net Savings
100% Demand Savings								
Max. Thermal	90%	100%	1,576,800	7,358	$118,166	$23,545	$47,837	$93,874
Base Case	90%	86%	1,576,800	6,356	$118,166	$20,339	$47,837	$90,668
50% Demand Savings								
Max. Thermal	90%	100%	1,576,800	7,358	$104,022	$23,545	$47,837	$79,730
Base Case	90%	86%	1,576,800	6,356	$104,022	$20,339	$47,837	$76,524
No Demand Savings								
Max. Thermal	90%	100%	1,576,800	7,358	$89,878	$23,545	$47,837	$65,586
Base Case	90%	86%	1,576,800	6,356	$89,878	$20,339	$47,837	$62,380

Assumptions:

Natural Gas Rate: $3.20/MBtu

Fuel Cell Thermal Output: 700,000 Btu/hour

Fuel Cell Electrical Efficiency: 36%

ECF = Fuel cell electric capacity factor

TU = Thermal utilization

4 Conclusions and Recommendations:

This study concludes that the hospital at Little Rock Air Force Base, AR represents a good application for an ONSI 200 kW PC25C fuel cell. It should be located in the courtyard adjacent to the mechanical room. No security fence will be required around the power plant. However, a fence is required around the nitrogen bottles. Electrical and thermal runs are relatively short. The fuel cell will operate in the grid connect mode only.

Net energy savings from the fuel cell using the existing rate and an 86 percent thermal utilization are estimated to be $90,668.

Appendix: Fuel Cell Site Evaluation Form

Site Name: **Little Rock Air Force Base**

Contacts: **Mr. Joe Johnston, Energy Manager**

Location: **Jacksonville, AR**

1. **Electric Utility: Arkansas Power and Light** Rate Schedule: **PT4**

2. Gas Utility: **ARKLA** Rate Schedule: **Commercial Rate**

3. Available Fuels: **Natural Gas** Capacity Rate:

4. Hours of Use and Percent Occupied:
   Hospital occupied continuously
   Peak occupancy 7:30 am -4:30 pm M-F

Weekdays	5	Hrs.	24
Saturday	1	Hrs.	24
Sunday	1	Hrs.	24

5. Outdoor Temperature Range:
   Winter Design Temperature: 20 °F
   Summer Design Temperature: 96 °F

6. Environmental Issues: **None.**

7. Backup Power Need/Requirement: **Two back-up generators for hospital (750 kW & 200 kW).**

8. Utility Interconnect/Power Quality Issues: **Existing back-up generators are not reliable; Power quality is an issue for hospital equipment operation; Easy access to existing electrical panels**

9. On-site Personnel Capabilities: **Boiler plant personnel at facility; HVAC personnel at facility**

10. Access for Fuel Cell Installation: **O.K.—Courtyard adjacent to mechanical room, electrical panels and existing back-up generators has adequate space and access for the fuel cell. The courtyard is level and is accessible for a crane.**

11. Daily Load Profile Availability: **None available.**

12. Security: **No security fence will be required around the fuel cell. A fence is required around the nitrogen tanks**

Site Layout

Facility Type: **Hospital** Age: **Constructed 1962**
Construction: **Concrete with exterior brick facing and built up roof.**
Square Feet: **52,403 sq ft**

See Figure 2

Show:

electrical/thermal/gas/water interfaces and length of runs
drainage
building/fuel cell site dimensions
ground obstructions

Electrical System

Service Rating: **277/480 V at Hospital. Base distribution at 13,800 V.**

Electrically Sensitive Equipment: **Computers and Medical Equipment**

Largest Motors (hp, usage): **N/A**

Grid Independent Operation?: **Desired to reduce the possibility of operating existing 200 kW back-up generator.**

Steam/Hot Water System

Description: **Three steam boilers provide heat for domestic hot water (DHW) and space heating loop.**

System Specifications:
Fuel Type: **Natural Gas**
Max Fuel Rate:
Storage Capacity/Type: **Three Domestic Hot Water Tanks, Capacity = 370 gal each**

Interface Pipe Size/Description: **4 in. at steam/hot water heat exchanger.**

End Use Description/Profile:

Steam generated by the three boilers is used for space heating, air conditioning reheat and autoclave sterilization.

Hot water is used for domestic hot water loads, space heating and air conditioning reheat.

Space Cooling System

Description: **Central chilled water plant with distributed air handlers located in penthouses on the roof of the hospital. The air handlers are configured for humidity control by means of cool reheat. Hot water supply temperature for reheat about 110 °F.**

Air Conditioning Configuration: **Chiller #1**

Type: **Centrifugal**

Rating: **300 tons**

Make/Model: **Trane Model #: CVHE320 Chiller #2**
Type: **Centrifugal**
Rating: **300 tons**

Make/Model: **Trane Model #: CVHE320 Chiller #3**
Type: **Centrifugal**
Rating: **150 tons**

Make/Model: **McQuay Model #: EO48HAGO8ROX**

Seasonality Profile: **Typical months of cooling are May through October**

Space Heating System

Description: **Steam/hot water space heating heat exchangers located in mechanical room used to distribute hot water to penthouse air handling units.**

Fuel: **Natural Gas**

Rating:

Water Supply Temp: **March, April, November & December: 140 °F; January–February: 160 °F**

Water Return Temp: **March, April, November & December: 120 °F; January–February: 140 °F**

Make/Model: **Thermal Storage (space?): Three 370-gal hot water storage tanks**

Seasonality Profile: **Space heating generally required from November through April.**

CERL Distribution

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8
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14. ABSTRACT

Fuel cells are an environmentally clean, quiet, and a highly efficient method for generating electricity and heat from natural gas and other fuels. Researchers at the U.S. Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL) have actively participated in the development and application of advanced fuel cell technology since fiscal year 1993 (FY93), and have selected and evaluated application sites, supervised the design and installation of fuel cells, actively monitored the operation and maintenance of fuel cells, and compiled "lessons learned" for feedback to manufacturers for 29 of 30 commercially available fuel cell power plants and their thermal interfaces installed at Department of Defense (DoD) locations.

This report presents an overview of the information collected at Little Rock Air Force Base, AR, along with a conceptual fuel cell installation layout and description of potential benefits the technology can provide at that location. Similar summaries of the site evaluation surveys for the remaining 28 sites where CERL has managed and continues to monitor fuel cell installation and operation are available in the companion volumes to this report.

15. SUBJECT TERMS
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